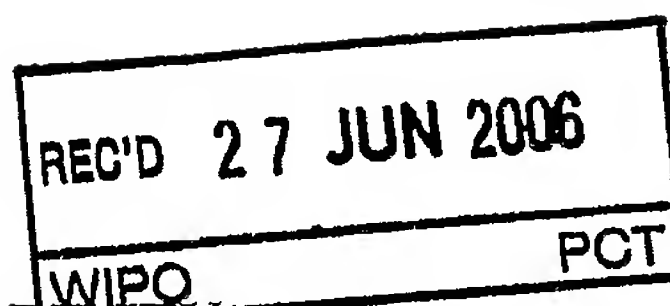


## PATENT COOPERATION TREATY

## PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference P16926PC/MH	<b>FOR FURTHER ACTION</b> See Form PCT/IPEA/416	
International application No. PCT/SE2004/000500	International filing date (day/month/year) 31-03-2004	Priority date (day/month/year)
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant Danaher Motion Stockholm AB et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
  - a. ☒ (sent to the applicant and to the International Bureau) a total of 4 sheets, as follows:
    - ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
    - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
  - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) \_\_\_\_\_, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- |                                     |              |                                                                                                                                                                 |
|-------------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | Box No. I    | Basis of the report                                                                                                                                             |
| <input type="checkbox"/>            | Box No. II   | Priority                                                                                                                                                        |
| <input type="checkbox"/>            | Box No. III  | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability                                                                |
| <input type="checkbox"/>            | Box No. IV   | Lack of unity of invention                                                                                                                                      |
| <input checked="" type="checkbox"/> | Box No. V    | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/>            | Box No. VI   | Certain documents cited                                                                                                                                         |
| <input type="checkbox"/>            | Box No. VII  | Certain defects in the international application                                                                                                                |
| <input type="checkbox"/>            | Box No. VIII | Certain observations on the international application                                                                                                           |

Date of submission of the demand  31-01-2006	Date of completion of this report  08-06-2006
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer  Magnus Westöö / itw Telephone No. +46 8 782 25 00

## Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Cover sheet

**International patent classification (IPC)**

**H02K 7/06** (2006.01)

**B62D 3/06** (2006.01)

**B62D 3/08** (2006.01)

**F16H 25/22** (2006.01)

**F16H 25/24** (2006.01)

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE2004/000500

## Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

- ☐ the international application in the language in which it was filed
- ☐ a translation of the international application into \_\_\_\_\_ ,  
which is the language of a translation furnished for the purposes of:
- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

- ☐ the international application as originally filed/furnished
- ☒ the description:  
pages 1 - 10 as originally filed/furnished  
pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_  
pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the claims:  
pages \_\_\_\_\_ as originally filed/furnished  
pages\* \_\_\_\_\_ as amended (together with any statement) under Article 19  
pages\* 1 - 4 received by this Authority on 30-05-2006  
pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the drawings:  
pages 1 / 8 - 8 / 8 as originally filed/furnished  
pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_  
pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (*specify*): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (*specify*): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

\* If item 4 applies, some or all of those sheets may be marked "superseded."

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE2004/000500

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

## 1. Statement

Novelty (N)	Claims	<u>1-22</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-22</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-22</u>	YES
	Claims		NO

## 2. Citations and explanations (Rule 70.7)

The following documents are cited in the International Search Report:

D1) US 2003117037 A1  
D2) US 6378646 B1  
D3) US 4588913 A  
D4) EP 1344709 A1

The present patent application relates to an electric motor or actuator intended for use as a linear steering motor in vehicles.

Document D1 relates to an electric motor or actuator comprising:

- a housing (14) encapsulating a rotating member (9),
- one or several arrangements (5, 6) for generating a magnetic field,
- a displaceable shaft (11) at least having exterior grooves (12),
- said rotating member (a nut) (9) having at least a portion with inner grooves (10) substantially corresponding to grooves (threaded) on said shaft (11),
- at least one magnetic element (8) arranged on an outer surface of said rotating member (9) substantially perpendicular to extension direction of said grooves (10) for interaction with said arrangements (5, 6) and rotating said member (9).

The device defined in claim 1 in the International Application differs from the prior art disclosed in document D1 in that there is arranged a carrying sleeve, as defined in lines 13-21 in claim 1. The sleeve allows the use of magnetic elements which can be manufactured in a simple shape and which may be attached to the sleeve surface in an easy way.

.../...

## Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box No. V

Thus, the invention defined in claim 1 is novel, and is deemed to involve an inventive step.

Analogically, the remaining independent claims 9, 20, 21 and 22 define novel matter, deemed to involve an inventive step.

The invention is industrially applicable.

Documents D2-D4 disclose the general state of the art.

P16926PC.C03, BA

CLAIMS

1. A device functioning as an electric motor or actuator (100, 100') comprising:
  - 5       - a housing (110) encapsulating a rotating member (120, 120'),
  - one or several arrangements (130, 130') for generating a magnetic field due to electrical current,
  - a displaceable shaft (140, 140') at least partly having exterior grooves (141, 141'),
  - 10       - said rotating member having at least a portion (121, 121') with inner grooves (122, 122') substantially corresponding to grooves on said shaft (140, 140'),
  - a carrying sleeve (123) being arranged to be provided on an outer surface of said rotating member (120, 120') substantially perpendicular to extension
  - 15       direction of said grooves (122, 122') for interaction with said arrangement (130, 130') and rotating said rotating membercharacterised in  
that said sleeve has an interior shape corresponding to an outer surface of the rotating member and an outer surface comprising portions (1231) for receiving a  
20       number of magnetic elements (150, 150'), said portions being arranged as flat portion and/or grooves for receiving said magnetic elements.
2. The device of claim 1, wherein said rotating element is a ball nut.
- 25   3. The device of claim 2, wherein said shaft is arranged as ball screw.
4. The device of claim 1, wherein said rotating element is a nut.
5. The device of claim 4, wherein said shaft is at least partly threaded.
- 30   6. The device of claim 1, comprising an air gap between said magnetic element and said sleeve.
7. The device according to any of preceding claims, wherein said shaft is made in  
35       sections of different parts.



8. The device of claim 7, wherein said parts are made of different material.

9. A device functioning as an electric motor or actuator (100) comprising:

- a housing (110) encapsulating a rotating member (120),
- 5 - one or several arrangements (130) for generating a magnetic field due to electrical current,
- a displaceable shaft (140) at least partly being arranged as a ball screw,
- said rotating member having a portion (121) being provided as a ball nut,
- 10 - magnetic elements (150, 150') arranged on an outer surface of a carrying sleeve arranged on said rotating member (120') substantially parallel with extension of said shaft for interaction with said arrangement (130) and rotating said ball nut

characterised in

15 that said sleeve has an interior shape corresponding to an outer surface of the rotating member and an outer surface comprising portions (1231) for receiving a number of magnetic elements (150, 150'), said portions being arranged as flat portion and/or grooves for receiving said magnetic elements.

20 10. The arrangement of claim 9, wherein said sleeve is made of a laminated material.

11. The arrangement of claim 10, wherein said shaft comprises ball return.

25 12. The arrangement of claim 11, wherein said ball return comprises a notch (6211) arranged diagonally on the ball nut (621), a preload system (6212), a return cap (6213) and a wiper (6214) arranged between the return cap and the shaft (6142), grooves or ball tracks (6141) in which the balls (6125) run.

30 13. The arrangement of claim 12, wherein said ball return comprises a single liner screw in which a notch (6211) forces balls (6125) passing through the notch to change track to the adjacent track.

14. The arrangement of claim 12, wherein said ball return comprises a ball nut having multi linear ball return.

35 15. The arrangement of claim 12, wherein said ball return comprises a single- or multi liner system, in which the balls are lead back after each circulation around the shaft

and the liner picks the balls out of a ball track and guides them with its path over the portion between the ball tracks of the shaft.

5 16. The arrangement of claim 9, wherein the shaft (9141) is provided with a return cap (9147) having a return channel (9148), wherein return cap system picks the balls up at one end of the nut and lead them back, through a hole in the nut, to the other side.

10 17. The arrangement of claim 12, wherein said ball return comprises a liner return (10142) placed in the shaft (10141) and the balls (10125) are lead through its path over a portion between the ball tracks (10122) of the nut

15 18. The arrangement of claim 9, wherein said shaft comprises means for transforming rotation of the nut to an axial movement.

19. The arrangement of claim 9, wherein said housing is at least partly filled with a lubrication agent.

20 20. A vehicle having steering wheels and including an actuator (100, 100') comprising:  
- a housing (110) encapsulating a rotating member (120, 120'),  
- one or several arrangements (130, 130') for generating a magnetic field due to electrical current,  
- a displaceable shaft (140, 140') at least partly having exterior grooves (141, 141'),  
25 - said rotating member having a portion (121, 121') with inner grooves (122, 122') corresponding to grooves on said shaft (140, 140'),  
- a carrying sleeve having magnetic elements (150, 150') arranged on an outer surface of said sleeve, being arranged on said rotating member (120') substantially parallel with extension of said grooves (122, 122') for  
30 interaction with said arrangement (130, 130') and rotating said rotating member

characterised in  
that said sleeve has an interior shape corresponding to an outer surface of the rotating member and an outer surface comprising portions (1231) for receiving a  
35 number of magnetic elements (150, 150'), said portions being arranged as flat portion and/or grooves for receiving said magnetic elements.



21. A method of actuating and object using a device functioning as an electric motor or actuator (100), comprising:

- a housing (110) encapsulating a rotating member (120),
- one or several arrangements (130) for generating a magnetic field due to electrical current,
- a displaceable shaft (140) at least partly being arranged as a ball screw,
- said rotating member having a portion (121) being provided as a ball nut,

the method comprising the steps of:

arranging magnetic elements (150, 150') on an outer surface of said rotating member (120') substantially parallel with extension of said shaft for interaction with said arrangement (130) and rotating said ball nut, and energizing said stators to rotate said rotating member and transforming rotation of said rotating member to a linear movement.

22. A carrying sleeve for use in a device functioning as an actuator (100, 100'), said carrying sleeve comprises an outer surface provided with at least one space for receiving at least one magnetic element (150, 150'), and inner space for mounting on an outer surface of a rotatable member (120, 120'), characterised in said space comprises portions (1231) for receiving a number of magnetic elements (150, 150'), said portions being arranged as flat portion and/or grooves for receiving said magnetic elements.